Contribution ID: **35** Type: **Either**

Structural and Spectroscopic Characterization of N, B Bi-Doped and Difunctionalized Carbon Quantum Dots

Carbon quantum dots are a type of 0D spherical nanomaterials with different types of properties such as chemical stability, biocompatibility, low toxicity, modulable band gap, photoluminescence, electrochemical, and heteroatomic doping. These properties have allowed these nanomaterials to be used in different kinds of applications such as in vitro and in vivo cellular imaging, fluorescent sensors to different analytes, drug delivery, anticancer therapy, and solar cell technology. In this work, we employed a novel microwave-assisted synthesis method to produce nitrogen and boron co-doped carbon dots. To achieve optimal synthesis, we conducted a parameter modulation, combining synthesis temperatures, times, and precursor concentrations, while keeping the power constant at 150 W and pH 5, where 120 °C, 3 min, and a precursor concentration of 1 mg/mL were found as optimal. Characterization with FE-SEM revealed these CDs to have a spherical morphology with an average size of 10.9 ± 3.38 nm. Further HR-TEM showed an interplanar distance of 0.23 nm, which is in line with prior findings of CDs that present a 0.21 nm distance corresponding to the (100) plane of graphite. UV–vis absorption showed distinct π–π*and* n–π transitions. Fluorescence spectroscopy highlighted an emission peak at 375 nm when excited at 295 nm, achieving a quantum yield of 56.7%. FTIR and Raman spectroscopy analyses confirmed the boronic acid and amine groups'presence, underscoring the graphitic nature of the core and the co-doping of boron and nitrogen. These empirical observations were compared with theoretical investigations through simulated Raman spectra, proposing a potential structure for the CDs. XPS further endorsed the co-doping of nitrogen and boron, along with the detection of the specified functional groups. All these characteristics could lend this nanomaterial to different types of applications such as fluorescent probes for a broad range of analytes and fluorescent cell imaging.

Keywords

carbon dots; co-doped carbon dots; difunctionalized carbon dots

Reference

Nanomaterials 2023, 13(20), 2753; https://doi.org/10.3390/nano13202753

This work was supported by

This research was funded by CIMAV grant number 25003 (internal project)
CONACYT Financial Aid CVU 744216

Author approval

I confirm

Author will attend

I confirm

Author: IBARRA PRIETO, Hector Daniel (CIMAV Monterrey)

Co-authors: Dr GARCÍA GARCÍA, Alejandra (CIMAV Monterrey); Dr NAVARRO IBARRA, Diana Carolina (Tecnológico Nacional de Mexico, Instituto Tecnológico del Valle de Etla); Dr GRANJA AGUILERA, Faustino (Instituto de Física "Manuel Sandoval Vallarta", Universidad Autónoma de San Luis Potosí); Dr RIVERO ESPEJEL, Ignacio (Tecnologico Nacional de Mexico Instituto Tecnologico de Tijuana)

Presenter: IBARRA PRIETO, Hector Daniel (CIMAV Monterrey)

Session Classification: NANOSTRUCTURES

Track Classification: Nanostructures